LONDON-WEST MIDLANDS ENVIRONMENTAL STATEMENT

Volume 5 | Technical Appendices

CFA4 | Kilburn (Brent) to Old Oak Common

Flood risk assessment (WR-003-004)

Water resources

November 2013

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Department for Transport

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1 Introduction

1.1 Structure of the water resources and flood risk assessment appendices

1.1.1 The water resources and flood risk assessment appendices comprise four parts. The first of these is a route-wide appendix (Volume 5: Appendix WR-001-000).

1.1.2 Specific appendices for each community forum area (CFA) are also provided. For the Kilburn (Brent) to Old Oak Common area (CFA4), these are:

- a water resources assessment (Volume 5: Appendix WR-002-004);
- a flood risk assessment (i.e. this appendix); and
- a hydraulic modelling report for a breach of the Grand Union Canal (Paddington Branch) at Old Oak Common (Volume 5: Appendix WR-004-001).

1.1.3 Maps referred to throughout the water resources and flood risk assessment appendices are contained in the Volume 5, Water Resources and Flood Risk Assessment Map Book.

1.2 Scope and structure of this assessment

1.2.1 This flood risk assessment (FRA) considers the assessment of flood risk within CFA4. The assessment has been carried out in accordance with the requirements of the National Planning Policy Framework (NPPF)[1] which aims to prevent inappropriate development in areas at risk of flooding and to ensure that, where development is necessary in areas at risk of flooding, it is safe without increasing flood risk elsewhere.

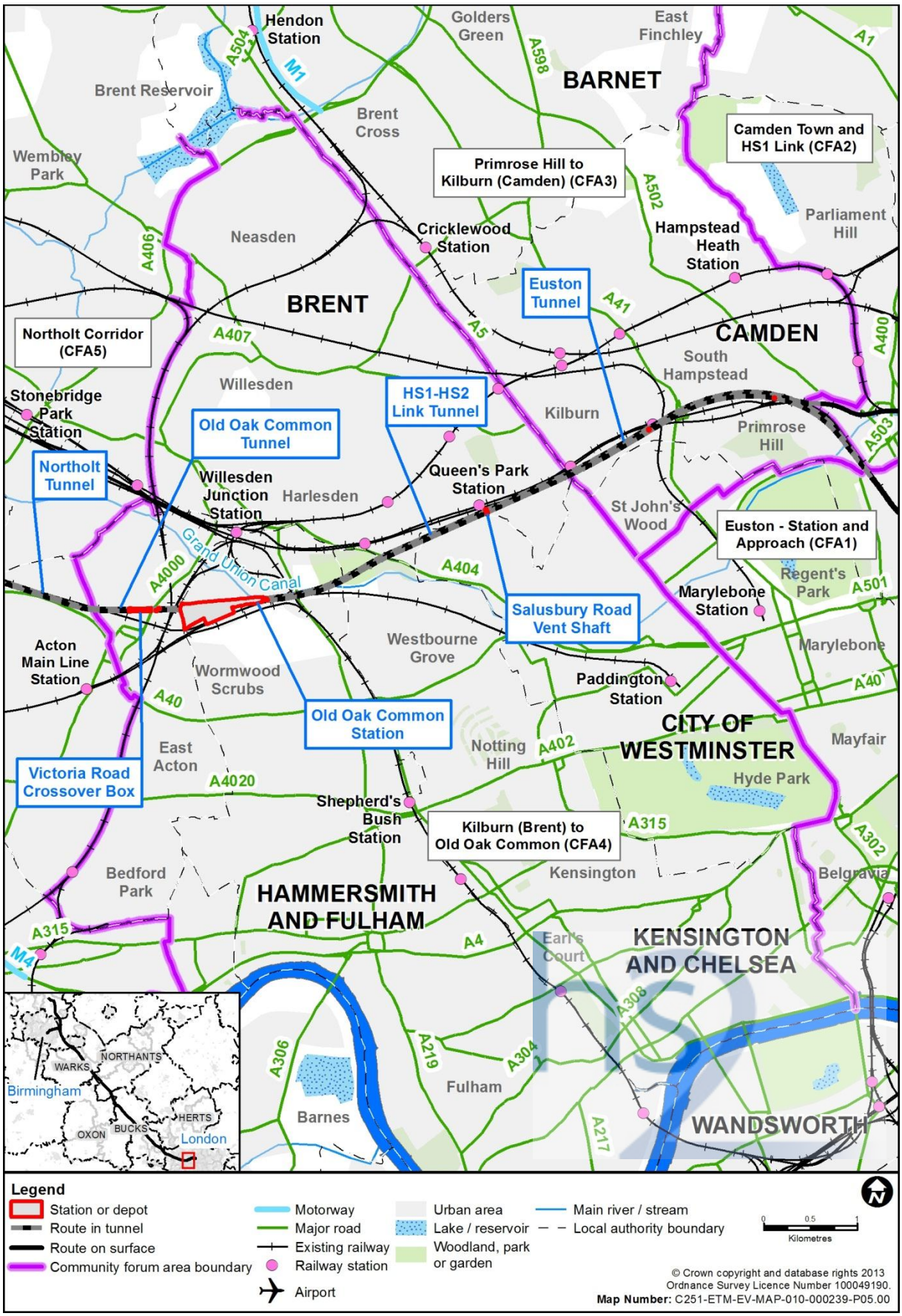
1.2.2 The FRA methodology and a review of the relevant local planning policy documents are provided in Section 2 of this report. The design criteria are provided in Section 3 and Section 4 documents the sources of information that have been reviewed. Section 5 provides a description of the planned works within CFA1. Section 6 considers baseline flood risk and the risk of flooding to the Proposed Scheme from all relevant sources. Flood risk mitigation measures included within the Proposed Scheme are detailed in Section 7. The effect of the Proposed Scheme on the risk of flooding is considered in Section 8.

1.3 Location

1.3.1 CFA4 covers a section of the Proposed Scheme that is approximately 5.4km long, running in an east to west direction. It extends from the A5 Kilburn High Road in the east to the B4492 Park Royal Road in the west. CFA4 is located between the Primrose Hill to Kilburn (Camden) area (CFA3) to the south-east and the Northolt Corridor area (CFA5) to the north-west, as shown in Figure 1.

[1] Department for Communities and Local Government (2012), *National Planning Policy Framework*

Figure 1: Kilburn (Brent) to Old Oak Common area



1.3.2 The study area extends to a distance of 500m from the centre line of the route and includes the urban centres of Kilburn, Kensal Rise and Kensal Green to the north and West Kilburn to the south.

1.3.3 The route will cross the Paddington branch of the Grand Union Canal north of Wormwood Scrubs Common as identified using the surface water crossing (SWC) reference SWC-CFA4-01 on Map WR-01-004, E6 (Volume 5, Water Resources and Flood Risk Assessment Map Book).

2 Flood risk assessment methodology

2.1 Source-pathway-receptor model

2.1.1 Flood risk is assessed using the source-pathway-receptor model. In this model individual sources of flooding within the study area are identified. The primary source of flooding is rainfall which is a direct source in the short-term (surface water flooding) and can lead to flooding from watercourses (river flooding) and overloaded man-made collection systems (sewer flooding) in the short or medium-term. Stored rainfall, either naturally in below ground aquifers and natural lakes or artificially in impounded reservoirs and canals, can lead to flooding when the storage capacity of the system is exceeded. A final source of flooding arises from tidal effects and storm surges caused by low pressure systems over the sea.

2.1.2 For there to be a risk of flooding at an individual receptor there must be a pathway linking it to the source of flooding. The pathways within the study area are assessed by reviewing national datasets that show the spatial distribution of flood risk. The associated risk magnitude is then categorised.

2.1.3 Receptors considered in this assessment include the Proposed Scheme and existing development within 500m of the Proposed Scheme. The Proposed Scheme includes all associated permanent infrastructure. Areas of interest are identified through comparison of the national spatial datasets with the design drawings. Where a risk is identified mitigation is proposed in line with recommendations in the NPPF.

2.1.4 Existing receptors within the study area are identified using Ordnance Survey (OS) mapping information. A high-level screening assessment is then undertaken to identify receptors that are within or in close proximity to an area of flood risk via pathways indicated using the flood risk data sources listed below. The vulnerability of each receptor is classified using Table 2 of the NPPF Technical Guidance Document[2].

2.1.5 The assessment then considers the vulnerability of the receptor with reference to the flood risk category of the source using Table 3 of the NPPF Technical Guidance Document and assesses whether the Proposed Scheme has any potential to influence or alter the risk of flooding to each receptor. Where such potential has been identified, mitigation is proposed based on further analysis.

2.2 Flood risk categories

2.2.1 The level of flood risk is categorised by assessing the design elements against the datasets for each source. A matrix showing the flood risk category associated with each flooding source is presented in Table 1.

[2] Department for Communities and Local Government (2012), *National Planning Policy Framework Technical Guidance.*

Table 1: Flood risk category matrix for all flooding sources

Source of flooding	Flood risk category				
	No risk	**Low**	**Medium**	**High**	**Very high**
Rivers		Flood Zone 1	Flood Zone 2	Flood Zone 3a	Flood Zone 3b
Surface water	No surface water flooding.	Surface water flooding <0.3m for 1 in 200 years event.	Surface water flooding >0.3m for 1 in 200 years event; and Surface water flooding <0.3m for 1 in 30 years event.	Surface water flooding >0.3m for 1 in 30 years event.	
Groundwater		Very low-low	Moderate	High-very high	
Drainage and sewer systems	No sewer in vicinity of site.	Surcharge point >20m from site and no pathways.	Surcharge point within 20m of site and restricted pathways.	Sewer network crosses site and pathways exist.	
Artificial sources	Outside of inundation mapping/no pathway exists.	Within inundation mapping/ pathway exists.			

2.3 Regional and local flooding planning policy documents

2.3.1 The lead local flood authority (LLFA) for the study area lies with the local planning authorities. Preliminary flood risk assessment (PFRA) reports produced by relevant LLFA have been reviewed from the London Borough of Brent (LBB)[3], the City of Westminster (CoW)[4], the Royal Borough of Kensington and Chelsea (RBKC)[5], the London Borough of Hammersmith and Fulham (LBHF)[6], and the London Borough of Ealing (LBE)[7]. In addition, draft surface water management plans have been produced by RBKC[8] and LBB[9]. None of the LLFA have as of yet produced a local flood risk management strategy (LFRMS).

2.3.2 The local development framework (LDF) core strategy was adopted for LBB[10] in July 2010, CoW[11] in January 2011, RBKC[12] in December 2010, LBHF[13] in October 2011 and LBE[14] in April 2012.

[3] Hyder/AECOM (2011), *London Borough of Brent Preliminary Flood Risk Assessment.*
[4] Halcrow (2011), *City of Westminster Preliminary Flood Risk Assessment.*
[5] Halcrow (2011), *Royal Borough of Kensington and Chelsea Preliminary Flood Risk Assessment.*
[6] Halcrow (2011), *London Borough of Hammersmith and Fulham Preliminary Flood Risk Assessment.*
[7] Capita Symonds (2011), *Ealing Council Preliminary Flood Risk Assessment.*
[8] Halcrow/MWH (2012), *Royal Borough of Kensington and Chelsea draft Surface Water Management Plan.*
[9] Hyder/AECOM (2011), *London Borough of Brent Surface Water Management Plan*.
[10] London Borough of Brent (2010), *Adopted Core Strategy*.

2.3.3 Each LLFA within Greater London, acting as the local planning authority, has also produced a strategic flood risk assessment (SFRA) which has been used as context and to provide baseline data for the assessment of flood risk for CFA4. SFRA reports have been reviewed for the LBB[15], CoW[16], RBKC and LBHF[17], and LBE[18].

Thames Region Catchment Flood Management Plan

2.3.4 The Thames Region Catchment Flood Management Plan (CFMP)[19] sets out policies for the sustainable management of flood risk across the Thames catchment over the coming 50-100 years taking climate change into account. The study area lies within the TE2100 Policy Unit and the preferred policy is Policy 4 which includes areas of low, moderate or high risk where the Environment Agency is already managing the flood risk effectively, but where further action may need to be taken to keep pace with climate change.

2.3.5 The Thames Region CFMP recommends that the most sustainable approach to managing future flood risk will be to bring about adaptation of the urban environment. It states that strategic scale planning is key to achieving the needs of the community and managing flood risk in a more sustainable way, and that emergency planning is integral to the approach to managing extreme flood events.

London Regional Flood Risk Appraisal

2.3.6 The London Regional Flood Risk Appraisal (RFRA)[20] provides a broad regional understanding of the risk of flooding in Greater London to feed into each of the LLFA SFRA and PFRA reports. Recommendation seven states that regeneration and redevelopment of London's river corridors offers a crucial opportunity to reduce flood risk in these areas.

London Plan

2.3.7 Policy 5.12 of the London Plan[21] states that development proposals must comply with flood risk assessment and management requirements set out in the NPPF. Policy 5.13 states that development should utilise sustainable drainage systems (SuDS) with the aim of achieving greenfield runoff rates unless there are practical reasons why they should not be used.

Lead local flood authority preliminary flood risk assessments

2.3.8 The recommendations from each of the LLFA PFRA reports have been reviewed in undertaking this assessment. The PFRA reports form the first stage of the

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[11] City of Westminster (2010), *Adopted Core Strategy.*
[12] Royal Borough of Kensington and Chelsea (2012), *Adopted Core Strategy.*
[13] London Borough of Hammersmith and Fulham (2011), *Adopted Core Strategy.*
[14] London Borough of Ealing (2012), *Adopted Development (or Core) Strategy.*
[15] Jacobs (2007), *London Borough of Brent Strategic Flood Risk Assessment.*
[16] City of Westminster (2010), *City of Westminster Strategic Flood Risk Assessment.*
[17] JBA/Entec (2010), *Royal Borough of Kensington and Chelsea and London Borough of Hammersmith and Fulham Strategic Flood Risk Assessment.*
[18] Capita Symonds (2008), *London Borough of Ealing Strategic Flood Risk Assessment.*
[19] Environment Agency (2008), *Thames Catchment Flood Management Plan.*
[20] Greater London Authority (2009), *London Regional Flood Risk Appraisal.*
[21] Greater London Authority (2011), *London Plan.*

requirements of the Flood Risk Regulations 2009[22] and identify historical flooding incidents within the borough as well as providing an understanding of the future flood risk from all sources of flooding other than main rivers. The PFRA reports confirm that there are no indicative flood risk areas of national significance within the study area.

2.3.9 All LLFA PFRA reports within the study area state that the locally agreed surface water information dataset is from the modelling activities undertaken as part of the Drain London project for the production of the PFRA reports.

Royal Borough of Kensington and Chelsea and London Borough of Brent Surface Water Management Plans

2.3.10 The surface water management plans build upon the assessment of the risk of surface water flooding within RBKC and LBB. There are no critical drainage areas within the study area as identified in either of the surface water management plans.

London Borough of Brent Strategic Flood Risk Assessment

2.3.11 The LBB Level 1 SFRA was completed in 2007. The LBB SFRA acknowledges the high risk of surface water and sewer flooding in the area, but dismisses the risks of groundwater flooding as minimal. The LBB SFRA recommends that the council take a proactive approach to managing the risk of flooding in the borough by requiring a positive contribution to reductions in the risk of flooding from developments.

City of Westminster Strategic Flood Risk Assessment

2.3.12 The CoW SFRA focuses primarily on the risk of flooding from the tidal River Thames and a potential breach of the existing flood defences. The report states that, due to the heavily urbanised nature of the CoW, surface water flooding is the more probable cause of flooding.

Royal Borough of Kensington and Chelsea and London Borough of Hammersmith and Fulham Strategic Flood Risk Assessment

2.3.13 The RBKC and LBHF SFRA focuses primarily on the risk of flooding from the tidal River Thames, although it does state that there is a general risk of flooding from surface water and sewers. The RBKC and LBHF SFRA states that the Grand Union Canal (Paddington Branch) in the north of the two boroughs is likely to act as a conveyor of surface water in an extreme event and it is likely to convey flow out of the boroughs due to the topography.

London Borough of Ealing Strategic Flood Risk Assessment

2.3.14 The LBE SFRA provides information on flooding in the borough and provides a supportive framework for assessing flood risk in planning policy.

2.3.15 Relevant policy recommendations within the LBE SFRA include the following:

- the use of SuDS to restrict surface runoff from development sites;
- achieve a positive reduction in the risk of flooding where possible;

[22] *Flood Risk Regulations 2009* (SI 2009 No. 3042), London, Her Majesty's Stationery Office.

- no development should increase flood risk;
- conveyance and storage should be improved in all systems; and
- all flow routes should be preserved.

Brent Core Strategy and Unitary Development Plan

2.3.16 Saved Brent Unitary Development Plan (UDP) Policy EP10[23] seeks to prevent harm to water resources, in particular preventing further culverting or canalisation of surface water. Restoration of watercourses to their natural state is encouraged under the policy. Saved UDP Policy EP12 seeks to prevent any new development on land liable to river flooding, unless appropriate replacement floodplain storage measures are taken.

City of Westminster Core Strategy

2.3.17 CoW Core Strategy Policy CS29 requires that all development take flood risk into account and should seek to reduce the risk of flooding.

Royal Borough of Kensington and Chelsea Core Strategy

2.3.18 Policy CE2 of the RBKC adopted Core Strategy seeks to mitigate the effects of, and adapt to, surface water and sewer flooding alongside reducing the volume and speed of surface water runoff to the drainage system.

London Borough of Hammersmith and Fulham Core Strategy

2.3.19 Hammersmith and Fulham, through Policy CC2 of its Core Strategy, seeks to minimise current and future flood risk through site specific flood risk assessment and appropriate mitigation. The policy also seeks to reduce the risk of flooding from surface and foul water.

London Borough of Ealing Core Strategy

2.3.20 Policy 1.2 (m) of the LBC adopted Core Strategy seeks to reduce the overall level of flood risk through the layout and form of new development and the appropriate application of sustainable drainage techniques. Under policies 5.2 and 5.3 metropolitan open land and green corridors will be sensitively managed for flood risk purposes. Saved UDP[24] Policy 2.5 seeks to ensure there is sustainable management of drainage infrastructure, flood risk, surface water runoff and water recycling.

[23] London Borough of Brent (2004), *Adopted Unitary Development Plan, Saved Polices*.
[24] London Borough of Ealing (2004), *Adopted Unitary Development Plan, Saved Policies.*

3 Design criteria

3.1.1 It is a requirement of the design that the Proposed Scheme shall be protected against flooding from any source during the 1 in 1,000 years return period (0.1% annual probability) rainfall event with water levels not rising closer than 1m to the top of rail level.

3.1.2 In accordance with the NPPF an allowance for climate change is included in the assessment by assuming that peak rainfall intensity will increase by 30%, and that peak river flows will increase by 20%.

4 Data sources

4.1 Primary datasets

4.1.1 Consistent with the requirements of the NPPF this assessment considers the risk of flooding from rivers, direct surface water runoff, rising groundwater, overwhelmed drainage and sewer systems, and artificial sources such as reservoirs, lakes and canals.

4.1.2 The Proposed Scheme lies entirely outside the extent of flooding from the sea and therefore the risk of flooding from tidal sources is not considered in this assessment.

4.1.3 The primary datasets for each source of flooding used to assess the design elements are presented in Table 2. A high-level review of the risk of flooding and potential impacts is undertaken on the basis of these datasets across all flood sources. Where this review indicates potentially significant impacts on the risk of flooding, or a risk of flooding to the line, further investigation in the form of hydraulic modelling is undertaken.

Table 2: Flood risk assessment data sources

Source of flooding	Datasets reviewed	Data owner
Rivers	Flood zone mapping. Detailed River Network. Catchment hydraulic models.	Environment Agency
Surface water	Flood Map for Surface Water (FMfSW). Local surface water flood mapping.	Environment Agency LLFA
Groundwater	Areas susceptible to groundwater flooding. 1:50,000 geological mapping (superficial and bedrock). Potential for elevated groundwater.	British Geological Survey (BGS) LLFA
Drainage and sewer systems	Sewer network plans. Lost river location plans.	Thames Water Utilities Limited (TWUL) Local planning authority
Artificial sources	Reservoir inundation mapping. Canal infrastructure locations. Trunk water main asset plans.	Environment Agency Canal & River Trust TWUL

4.2 Site familiarisation visits

4.2.1 A site familiarisation survey was undertaken at the Grand Union Canal (Paddington Branch) in March 2013.

5 The proposed development

5.1 Topography and land use

5.1.1 The local topography within CFA4 generally slopes from north to south. The topography has been artificially modified by industrial activities; for example the excavation of the siding for the Great Western Main Line (GWML) and the creation of the Grand Union Canal (Paddington Branch). The land use in this area is heavily urbanised, with the residential centres of Kilburn and Kensal Green. To the west of CFA4 there is a substantial area of industrial warehousing. Between the residential areas to the east and the industrial area to the west lie Kensal Green and St Mary's cemeteries, and Wormwood Scrubs Common.

5.1.2 The GWML, West Coast Main Line (WCML), London Overground (LO) and London Underground (LU) lines, Central Line and Bakerloo Line all pass through CFA4. These lines are all above ground and contribute a significant amount towards the total land use of CFA4.

5.2 Local flood risk receptors

5.2.1 The vulnerability of each local receptor with an identified pathway within the study area is presented in Table 3. The vulnerability is classified in accordance with the recommendations of Table 2 in the NPPF technical guidance document and the Scope and Methodology Report (SMR) (see Volume 5: Appendix CT-001-000/1) and the SMR Addendum (see Volume 5: Appendix CT-001-000/2).

Table 3: Vulnerability of local receptors in CFA4

Local receptor	Description	Vulnerability classification	Source/pathway
Kilburn urban centre	Residential dwellings and associated infrastructure	More vulnerable	Surface water 30 years - deep
Queen's Park and West Kilburn urban centres	Residential dwellings and associated infrastructure	More vulnerable	Surface water 30 years - deep
Kensal Green urban centre	Residential dwellings and associated infrastructure	More vulnerable	Surface water 30 years - shallow
Kensal Green and St Mary's cemeteries	Cemetery and crematorium	Less vulnerable/water compatible	Surface water 30 years - shallow
Old Oak Common railway depot	Railway infrastructure	More vulnerable	Surface water 30 years - shallow Grand Union Canal (Paddington Branch)
Wormwood Scrubs Common	Recreational area	Water compatible	Surface water 30 years - shallow Grand Union Canal (Paddington Branch)
Wormwood Scrubs Prison	Prison	More vulnerable	Surface water 30 years -

Local receptor	Description	Vulnerability classification	Source/pathway
			shallow
Hammersmith Hospital	Hospital	More vulnerable	Surface water 30 years - deep
Queen Charlotte's & Chelsea Hospital	Hospital	More vulnerable	Surface water 30 years - deep
East Acton urban centre	Residential dwellings and associated infrastructure	More vulnerable	Surface water 30 years - deep
North Acton industrial area	Industrial park and warehousing	Less vulnerable	Surface water 30 years - deep

5.3 Description of the Proposed Scheme

5.3.1 The Proposed Scheme through CFA4 will be approximately 5.4km in length and will commence at the A5 Kilburn High Road. The permanent features of the Proposed Scheme are shown on Map CT-06-006 to Map CT-06-010 (Volume 2, CFA4 Map Book).

5.3.2 The route section will be mainly in tunnel, as it proceeds south-west towards Old Oak Common. There will be a ventilation and intervention shaft (vent shaft) at Salusbury Road in Queen's Park. The route will continue westwards for a further 2.6km into a triangular site at Old Oak Common. Within the triangular site a new HS2 interchange station and associated infrastructure, known as Old Oak Common station, will be constructed.

5.3.3 Twin-bore tunnels will pass through the area between Euston station (in CFA1) to West Ruislip (in CFA6). The section of the route between Euston and Old Oak Common station is referred to as the Euston tunnel. To the west of the Old Oak Common site, the Proposed Scheme will continue in short twin-bored tunnels (referred to as the Old Oak Common tunnel), beneath Wells House Road and will connect with the Victoria Road crossover box (a facility to allow HS2 trains to change tracks) and vent shafts located between Chase Road, to the west and the A4000 Victoria Road to the east. From here the route will continue west in twin bore tunnels beneath Acton Cemetery and will enter the adjacent Northolt Corridor area (CFA5) beneath the B4492 Park Royal Road. This tunnel to the west of the crossover box is known as the Northolt tunnel.

5.3.4 A single-bore tunnel will link Old Oak Common station to the HS1-HS2 Link portal located north-west of Primrose Hill (in CFA2). The HS1-HS2 Link will then proceed through Camden on a series of viaducts which currently carry the London Overground and freight services to connect with the existing HS1 rail corridor.

6 Existing flood risk

6.1 Historical flooding incidents

6.1.1 None of the PFRA reports have identified any past floods that have had significant harmful consequences that would be reportable to the European Union (EU).

6.1.2 The LBB PFRA reports that a number of properties flooded during the July 2007 event, although the exact location of the flooded properties was not provided. The main cause of flooding was a combination of surface water runoff and inadequate sewer capacity. Anecdotal information has shown that the A4000 Victoria Road Bridge, close to the junction with Chandos Road, flooded in August 2004.

6.1.3 TWUL historical DG5 sewer flooding records presented in the PFRA reports show that there have been a number of sewer flooding incidents within the study area. Records are available within the respective PFRA reports to a resolution of four-figure postcode sector references. To the south of the route, close to the proposed Salusbury vent shaft, there is shown to be a hotspot of historical sewer flooding up to June 2010. This is within two adjacent postcode areas where sewer flooding incidents have occurred and have been recorded in the 21-50 range and 51-100 range respectively. To the south-west of the proposed station at Old Oak Common and the proposed Victoria Road crossover box there are two further adjacent postcode areas where again sewer flooding incidents have occurred and have been recorded in the 21-50 range and 51-100 range respectively.

6.2 Risk of flooding from rivers

6.2.1 The entire study area is within Flood Zone 1 and the probability of flooding from rivers is therefore less than a 0.1% (1 in 1,000) chance each year.

6.3 Risk of flooding from surface water

6.3.1 The Drain London modelling outputs and the Environment Agency FMfSW have been reviewed to form the basis of the assessment of the impact on the risk of surface water flooding. Each LLFA is generally reporting a good correlation between the FMfSW and the Drain London modelling. The Drain London modelling, however, considers the underground drainage infrastructure in a higher level of detail and is considered to be the more robust dataset. The FMfSW for CFA4 is shown on Map WR-01-004 (Volume 5, Water Resources and Flood Risk Assessment Map Book).

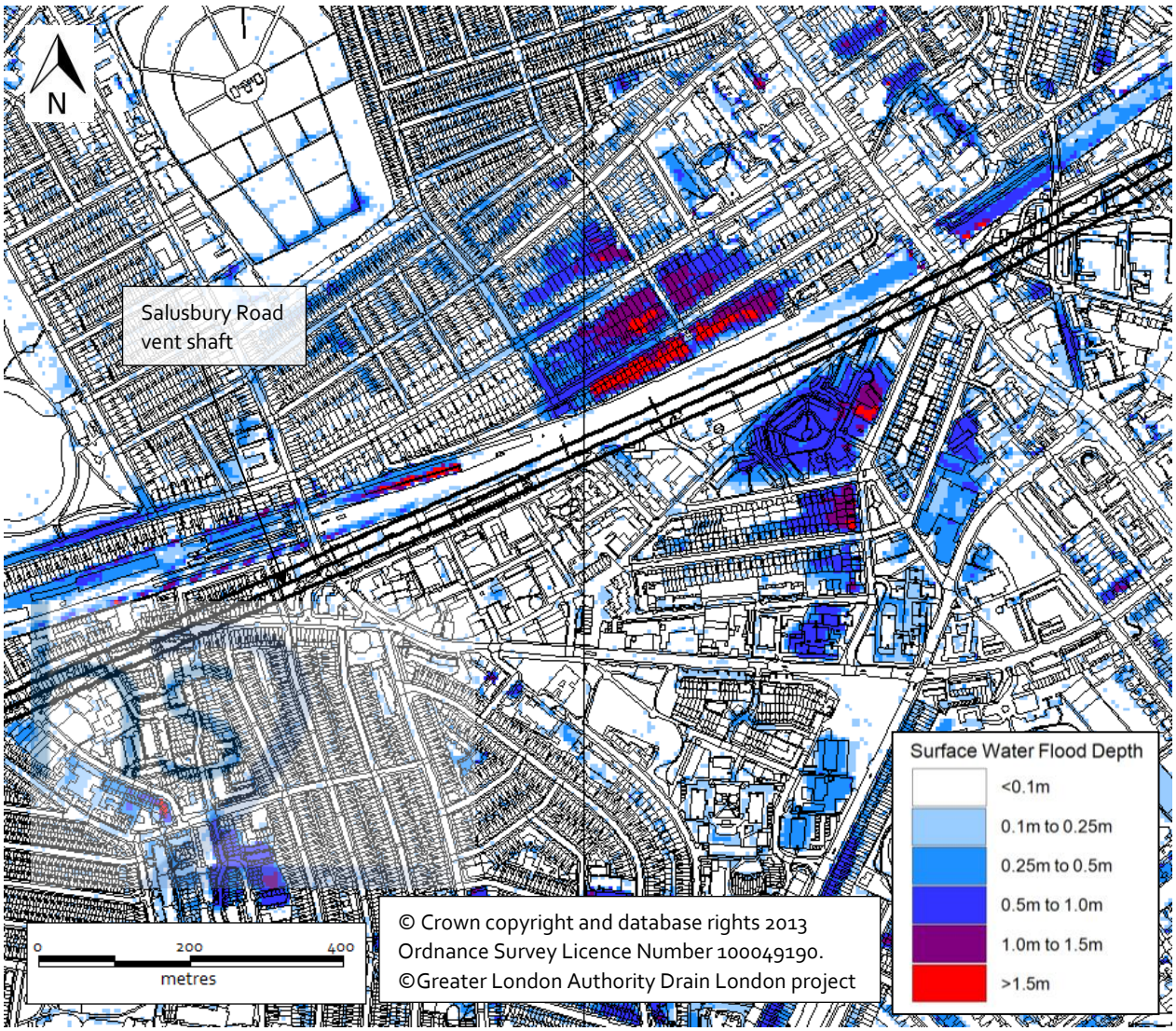
6.3.2 There are areas within the study area that have a high risk of surface water flooding. Since the route will be within tunnel for the majority of the study area the surface water flood risk has been considered only in the location of permanent above-ground infrastructure.

Salusbury Road vent shaft

6.3.3 Surface water flooding datasets from the PFRA reports show parts of the shared railway associated with the LO and LU Bakerloo lines between Kensal Green and Queens Park to be at risk of flooding during the 1 in 200 years return period (0.5% annual probability) flood event up to a depth of 1.5m (presented in Figure 2). The

Salusbury Road vent shaft will be located to the south of Queens Park Station, approximately 20m from the closest area at risk of surface water flooding, as shown on Map CT-06-007, G6 (Volume 2, CFA4 Map Book). The auto-transformer station will be located to the north of the vent shaft, closer to the area at risk of flooding.

Figure 2: 1 in 200 years return period (0.5% annual probability) surface water flood depth at the proposed Salusbury Road vent shaft (from preliminary flood risk assessments)



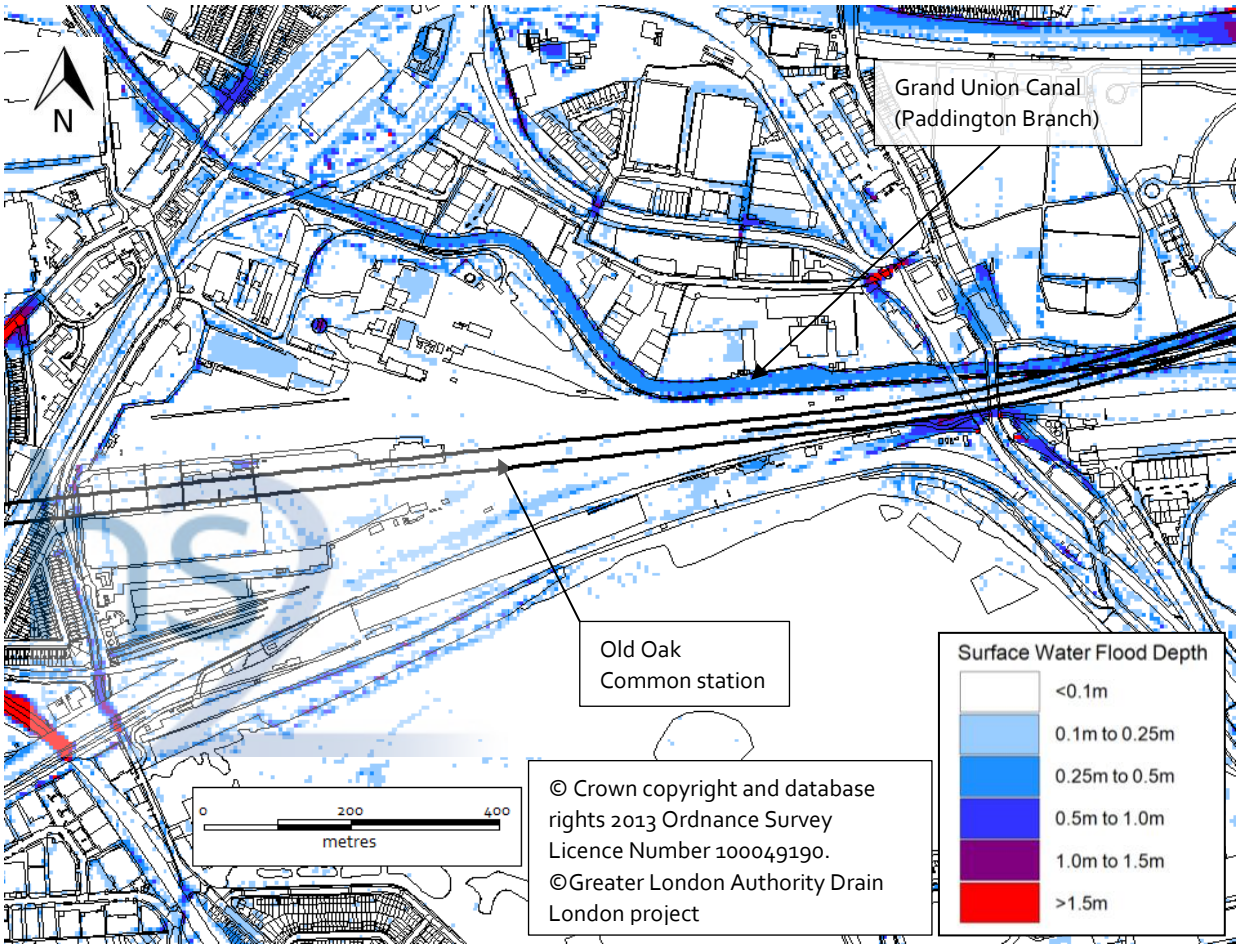
6.3.4 The ground level profiles suggest that the ground level at the vent shaft location is approximately 35m AOD. Based on light detection and ranging (LiDAR) information the railway level of the adjacent LU and LO lines is approximately 32m AOD - more than 3m below surrounding ground levels. There will therefore be a freeboard of at least 1.5m for the minimum threshold level of the vent shaft at this location and the 1 in 200 years return period (0.5% annual probability) flood water level.

6.3.5 There will be no significant risk of surface water flooding to the Proposed Scheme at the Salusbury Road vent shaft.

Old Oak Common station

6.3.6 The surface water flooding datasets from the PFRA reports show areas of the existing rail infrastructure at Old Oak Common to be at risk of flooding during the 1 in 200 years return period (0.5% annual probability) flood event (presented in Figure 3). Shallow flooding (<0.25m) in isolated spots is predicted in the area of the proposed station. Surface water flooding is predicted in the local depressions of the track beds of the GWML and associated rail infrastructure in the existing depot.

Figure 3: 1 in 200 years return period (0.5% annual probability) surface water flood depth at Old Oak Common station (from preliminary flood risk assessments)



6.3.7 Significant ground re-profiling is planned in the vicinity of the proposed Old Oak Common station as shown on Map CT-06-009 (Volume 2, CFA4 Map Book). The station itself will be excavated to a depth of approximately 16m and then covered; with two ventilation and emergency access structures and a station superstructure towards the centre of the excavation.

6.3.8 There will be a low risk of surface water flooding to the Proposed Scheme at Old Oak Common station.

A4000 Victoria Road Bridge

6.3.9 The surface water flooding datasets from the PFRA reports show the existing bridge on the A4000 Victoria Road to the north of the route to be at risk of flooding during

the 1 in 200 years return period (0.5% annual probability) flood event up to a depth of 1.5m (presented in Figure 5). The bridge is shown on Map CT-06-009, E3 (Volume 2, CFA4 Map Book). There is an existing raised pedestrian walkway on the south side of the road. Historical flooding has been recorded in this location. Figure 4 shows significant depths of flooding which occurred on 4 August 2004. Proposals are to widen this bridge to allow for heavier construction traffic between the Atlas Road satellite compound and the Victoria Road tunnel drive main compound.

Figure 4: Historical flooding at the A4000 Victoria Road Bridge, Acton on 4 August 2004[25]

6.3.10 There will be a high risk of surface water flooding at the A4000 Victoria Road Bridge. Construction work in this location is ancillary and is not directly associated with the route itself.

Victoria Road crossover box

6.3.11 The surface water flooding datasets from the PFRA reports show parts of the land in the vicinity of the proposed Victoria Road crossover box to be at risk of flooding during the 1 in 200 years return period (0.5% annual probability) flood event (presented in Figure 5). The crossover box is shown on Map CT-06-009, C4-D5 (Volume 2, CFA4 Map Book).

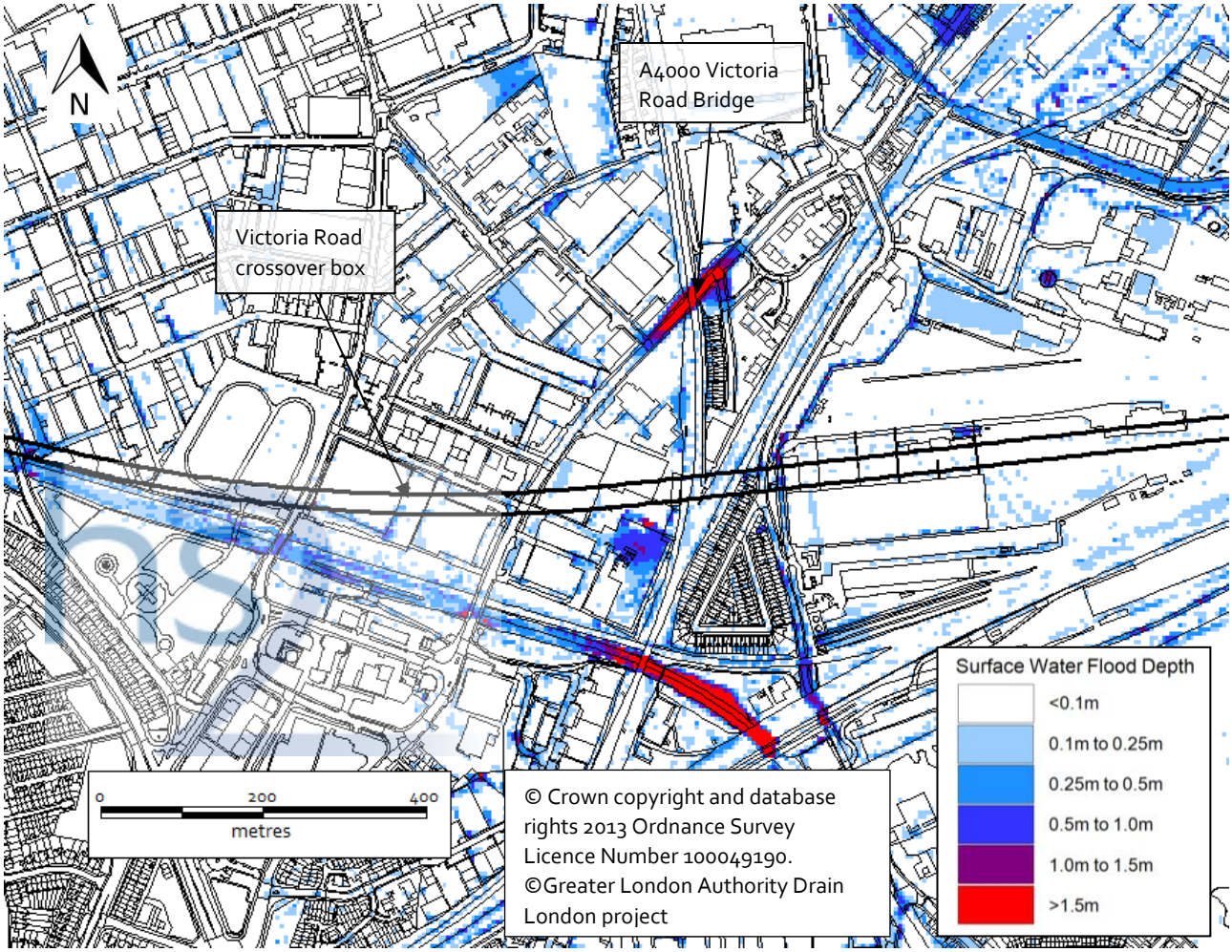
6.3.12 Over the majority of the area of the proposed Victoria Road crossover box, the maximum predicted depth of surface water flooding is less than 0.25m. There is, however, an area to the south-east of the proposed crossover box where localised flood depths could reach 1.5m during the 1 in 200 years return period (0.5% annual probability) flood event. This is caused by a topographic depression at the Quattro UK Ltd waste management and concrete batching plant where ground levels have been lowered. Proposals are to use this site for storage during construction and it has been assumed that ground levels will be restored prior to construction.

6.3.13 Based on LiDAR information, ground levels at the locations of the two structures for access and ventilation above the proposed crossover box are approximately 35m AOD for the western access structure and 32m AOD for the eastern access structure. The ground level within the Quattro UK Ltd site is approximately 28.5m AOD and is more than 3m below surrounding ground levels. There will therefore be a freeboard of at

[25] Evans, T. (2004) Historical flooding in Victoria Road, Acton. Accessed online: BBC News. URL: http://news.bbc.co.uk/media/images/39919000/jpg/_39919124_flood300b.jpg . Accessed: March 2013.

least 2m for the minimum threshold level of the access to the crossover box and the 1 in 200 years return period (0.5% annual probability) flood water level at this location.

Figure 5: 1 in 200 years return period (0.5% annual probability) surface water flood depth at the A4000 Victoria Road (from preliminary flood risk assessments)



6.3.14 There will be a low risk of surface water flooding to the Proposed Scheme at the Victoria Road crossover box.

6.4 Risk of flooding from groundwater

6.4.1 BGS geological mapping indicates that there are no superficial deposits present within the study area. The geological succession beneath the London Clay comprises:

- the Harwich Formation;
- the Lambeth Group;
- the Thanet Sand Formation; and
- the Cretaceous Chalk Group.

6.4.2 The PFRA reports do not show any areas to have an increased potential for elevated groundwater.

6.4.3 There will be no significant risk of groundwater flooding to the Proposed Scheme within the study area.

6.5 Risk of flooding from drainage systems

6.5.1 The route will cross a number of urban centres within CFA4 and above ground infrastructure will therefore be located close to the existing sewer network and associated manholes. The PFRA and SFRA reports have reported a number of historical incidents of sewer flooding. The exact location of these incidents, however, is not available.

6.5.2 As well as passing close to the existing local sewerage network, the Proposed Scheme will also pass to the north of the source of Counters Creek close to the Kensal Green Cemetery. At this location the creek is contained within the combined sewer network that flows directly into the Middle Level 1 Sewer.

6.5.3 The Proposed Scheme will run close to the source of the eastern branch of the Stamford Brook close to Wormwood Scrubs Common. According to TWUL records, the brook is contained within the local sewerage network and continues to its confluence with the River Thames, south of Hammersmith Town Hall. The route will not cross the western two branches of the Stamford Brook.

6.5.4 The sewer network in this area is predominantly combined and therefore the risk of flooding from sewers is considered to be comparable to the risk of flooding from surface water sources that has been previously described.

6.5.5 There will therefore be no additional significant risk of flooding from drainage and sewer systems to the Proposed Scheme within the study area above that specified in the previous section on the risk of flooding from surface water sources.

6.6 Risk of flooding from artificial sources

Canals

6.6.1 The Proposed Scheme will cross the Grand Union Canal (Paddington Branch) close to Old Oak Common, as shown on Map CT-06-008 (Volume 2, CFA4 Map Book). At this location the canal is retained on the southern side and managed water levels are approximately 1.75m above surrounding ground levels, rising to 4.5m. The towing path is 2.5m wide. Further to the west the towing path is on the south side of the canal at a level of approximately 30m AOD. Ground levels in the existing GWML railway to the south are approximately 25m AOD and the managed water level in the canal is therefore approximately 4.5m above ground levels on the site.

6.6.2 The land continues to fall away to the south through Wormwood Scrubs Common towards mixed land use including the residential area at Wulfstan Street, Wormwood Scrubs Prison, Queen Charlotte's & Chelsea Hospital, Hammersmith Hospital, Burlington Danes School and the Linford Christie Athletics Stadium.

6.6.3 The Canal & River Trust (formerly British Waterways) is responsible for the maintenance of the canal network and has confirmed that there are 43km of unrestrained water (i.e. no locks) on this reach of the Grand Union Canal (Paddington

Branch). Where the route will cross underneath the canal the LLFA is the LBHF. Flooding due to a breach of the retaining structures of the Grand Union Canal (Paddington Branch) is not considered in detail in the LBHF SFRA.

6.6.4 The canal continues to the west through the LBE. The LBE SFRA states that the maintenance programme adopted by the Canal & River Trust includes:

- monthly asset inspections from tow path looking for structural defects;
- inspections every three months by boat to assess the condition of both banks of the canal; and
- an annual visual engineering inspection undertaken by an engineer and an asset inspector.

6.6.5 Condition survey reports have been reviewed as part of this flood risk assessment. Network Rail has undertaken detailed examinations of the retaining wall (in February, March and October 2012), and the Canal & River Trust has provided a principal inspection report from March 2003[26]. The condition of the retaining wall on the bend adjacent to the proposed Old Oak Common station was assessed as being solid throughout when surveyed using an examination hammer. There were large areas that were not surveyed due to vegetation growth. The British Waterways survey in 2003 concluded that the condition of the retaining structure was Grade C (where Grade A is new/excellent and Grade E is bad/failing), and that the consequence of failure score for the retaining wall was five (i.e. major damage and risk to life).

6.6.6 The canal currently poses a flood risk to the site of the proposed station and surrounding area. Two-dimensional hydraulic modelling has been undertaken to determine the extent and depth of flooding associated with a breach of the retaining wall of the canal to inform the assessment of flood risk to the Proposed Scheme. For the baseline case, where no excavation activities have been undertaken, flood waters will flow to the south across the entrance to the current Crossrail storage facility before entering the track beds of the GWML. Flood waters will travel to the east and to the west along the GWML. Flood waters will also flow overland across Wormwood Scrubs Common.

6.6.7 Depths of flooding are expected to be in the order of approximately 0.2m–1m depending on the location of the assessment point, and the expected width of breach.

6.6.8 There will be a low residual risk of flooding from the Grand Union Canal (Paddington Branch) to the Proposed Scheme within the study area, due to the failure of the canal retaining structures.

Reservoirs

6.6.9 The Proposed Scheme will not cross any areas that are shown to have a residual risk of flooding from failure of impounded reservoirs.

[26] British Waterways (2003), *Investigation ESPI Project Principal Inspection Report Paddington Arm Grand Union Canal GP-01600R to GP-01715R Embankment Right side Project reference IE020011).*

Water mains

6.6.10 The Proposed Scheme will cross a number of TWUL water supply mains within the study area, the majority of which will be crossed where the route is in tunnel and therefore will not pose a risk of flooding to the Proposed Scheme.

6.6.11 Two water mains are identified as being within the structure of Mitre Bridge, the diameters of which are 533mm and 406mm. The excavations and headhouses at the proposed Old Oak Common station will be more than 500m away and the elevation of the track beds of the GWML are increasing in this location. It is therefore considered that a pathway does not exist between these flooding sources and the Proposed Scheme.

6.6.12 Two further 762mm diameter water mains are shown to be located along Old Oak Common Lane to the west of the proposed Old Oak Common station. A pathway will exist from these water mains to the proposed excavation. The displacement of the ground along the length of these water mains and the potential damage to the pipes due to additional strain in the material will be assessed prior to construction. It is assumed that any water main that is assessed as potentially enduring unacceptable strain will have mitigation undertaken to ensure its structural integrity is sound. The risk of failure of these water mains will therefore be low.

6.6.13 There is a further 304mm diameter water main located within the A4000 Victoria Road. It has been assumed that this water main will be diverted ahead of the excavation of the Victoria Road crossover box. The diversion will be undertaken using materials able to withstand any ground movement that will be experienced due to the excavation of the Victoria Road crossover box. The risk of failure of this diverted water main will therefore be low.

6.6.14 There will be a low risk of flooding from water mains to the Proposed Scheme at two locations within the study area due to water supply infrastructure failure.

6.7 Summary of baseline flood risk

Table 4: Summary of baseline flood risk for all sources of flooding in CFA4

Source of flooding	Location of flooding source	Flood risk category	Elements at risk	Assessment of risk
Surface water	Kensal Rise	No risk	Salusbury vent shaft and auto-transformer station	Proposed Scheme will be in tunnel. Ground level at shaft will be 1.5m above estimated flood level.
Surface water	Old Oak Common	Low 200 years Depth<0.3m	Old Oak Common station	No overland flowpaths. Ground levels will be raised at shaft and station structures.
Surface water	A4000 Victoria Road Bridge	High 30 years Depth>0.3m	Victoria Road Bridge	Ancillary construction. Will not be close to route itself.

Source of flooding	Location of flooding source	Flood risk category	Elements at risk	Assessment of risk
Surface water	A4000 Victoria Road	Low 200 years Depth<0.3m	Victoria Road crossover box	Majority of at risk areas associated with localised topographic depressions.
Artificial sources - Grand Union Canal (Paddington Branch)	Old Oak Common	Low Artificial source with pathway	Old Oak Common station	There will be a residual risk of flooding.
Artificial sources – water main	Mitre Bridge	No risk Source but no pathway	Old Oak Common station	Excavation will be too far from source to pose risk of flooding.
Artificial sources – water main	Old Oak Common Lane	Low Artificial source with pathway	Old Oak Common station	Settlement of water main will be assessed under TWUL guidance.
Artificial Sources – water main	A4000 Victoria Road	Low Artificial source with pathway	Victoria Road crossover box	Water main will be diverted.

7 Flood risk management measures

7.1 Risk of flooding from rivers

7.1.1 There are no instances where the Proposed Scheme will be at significant risk of river flooding, and consequently no mitigation is required.

7.2 Risk of flooding from surface water sources

7.2.1 There will not be a significant risk of flooding from surface water sources to the Proposed Scheme; therefore no specific mitigation will be required.

7.2.2 There will not be any anticipated changes to the risk of flooding from surface water sources as a result of the Proposed Scheme and therefore no specific mitigation will be required.

7.3 Risk of flooding from groundwater

7.3.1 There will be no risk of flooding from groundwater to the Proposed Scheme, nor will there be any anticipated effects on the risks of flooding from groundwater within the study area arising from the Proposed Scheme. Therefore, no specific mitigation will be required.

7.4 Risk of flooding from drainage systems

7.4.1 There will be no risk of flooding from drainage systems to the Proposed Scheme, nor will there be any anticipated effects on the risks of flooding from drainage systems within the study area arising from the Proposed Scheme. Therefore, no specific mitigation will be required.

7.5 Risk of flooding from artificial sources

7.5.1 Where the tunnels will pass beneath the Grand Union Canal (Paddington Branch), ground settlement could occur at the surface as a result of the tunnelling works. In addition, the canal retaining wall is shown to be located within the settlement contour of the proposed Old Oak Common station excavation. The possibility of movement, and potential failure of the canal retaining walls and towpath has therefore been considered.

7.5.2 An impact assessment of the retaining wall at Old Oak Common concludes that the predicted risk of damage to the masonry Old Oak Common retaining walls due to excavation of the tunnels is negligible.

7.5.3 Mitigation during excavation of the tunnels and the station box will incorporate targeted monitoring of the Grand Union Canal (Paddington Branch) retaining wall to assess any ground movement during construction activities that might have an effect on the structural integrity of the canal wall and trigger a potential breach with any resulting remedial works undertaken. This will ensure that the temporary effects of the tunnel and station box excavation works on flood risk are not significant.

8 Post-development flood risk assessment

8.1 Local receptors

8.1.1 In addition to the risk of flooding that exists to the Proposed Scheme, there is potential for the Proposed Scheme to affect the risk of flooding to third party receptors by altering flow mechanisms across the range of flood sources. All local receptors with a potential flood risk are identified in Section 5 of this report. For the Proposed Scheme to have an impact on a given receptor, the identified pathway for that receptor must be shared by both the subject receptor and the Proposed Scheme, with the result that a number of cases can be excluded immediately. Table 5 summarises the shared pathways between the Proposed Scheme and each receptor, and identifies cases where no shared pathway exists.

Table 5: Shared flood risk pathways in CFA4

Local receptor	Vulnerability classification as per the NPPF	Pathway	Shared pathway between Proposed Scheme and receptor
Kilburn urban centre	More vulnerable	Surface water 30 years - deep	No shared pathway.
Queen's Park and West Kilburn urban centres	More vulnerable	Surface water 30 years - deep	Salusbury vent shaft.
Kensal Green urban centre	More vulnerable	Surface water 30 years - shallow	No shared pathway.
Kensal Green and St Mary's Cemeteries	Less vulnerable/water compatible	Surface water 30 years - shallow	No shared pathway.
Old Oak Common railway depot	More vulnerable	Surface water 30 years - shallow Grand Union Canal (Paddington Branch)	Old Oak Common station.
Wormwood Scrubs Common	Water compatible	Surface water 30 years - shallow Grand Union Canal (Paddington Branch)	Old Oak Common station.
Wormwood Scrubs Prison	More vulnerable	Surface water 30 years - shallow	No shared pathway.
Hammersmith Hospital	More vulnerable	Surface water 30 years - deep	No shared pathway.
Queen Charlotte's & Chelsea Hospital	More vulnerable	Surface water 30 years - deep	No shared pathway.
East Acton urban centre	More vulnerable	Surface water 30 years - deep	Old Oak Common station.
North Acton industrial area	Less vulnerable	Surface water 30 years - deep	Victoria Road crossover box.

8.1.2 There is the potential for the Proposed Scheme to change the baseline risk of flooding described in Section 6 of this report. Though designed such that the probability of the Proposed Scheme flooding in any given year is less than 1 in 1,000, any change to the baseline risk of flooding could impact on the assessment of flood risk to the Proposed Scheme. All cases of flood risk discussed in Section 6 of this report are therefore reconsidered regardless of the presence or otherwise of third party local receptors.

8.2 Impact on risk of flooding from rivers

8.2.1 As the route will not cross any Environment Agency designated main rivers or ordinary watercourses within the study area, the Proposed Scheme will not lead to a change in the risk of flooding from rivers.

8.3 Impact on risk of flooding from surface water

8.3.1 The above ground infrastructure has the potential to alter overland flow routes, thereby changing the risk of flooding to local receptors. Surface water runoff from all permanent structures will be controlled at source by design and will prevent increased rates and volumes of surface water runoff overland flow to the local sewer network or above ground receptors.

Salusbury Road vent shaft

8.3.2 Above ground construction at the Salusbury Road vent shaft is proposed to be confined to the site bounded by Claremont Road to the west, Kilburn Lane to the south, Premier Corner to the east and the GWML to the north. The proposals will not extend beyond the existing retaining wall at the edge of the existing railway excavation where the most significant areas of surface water flooding are predicted.

8.3.3 The Proposed Scheme will therefore not lead to a change in the risk of flooding from surface water sources at the Salusbury Road vent shaft. There will therefore be no adverse effects on the risk of flooding from surface water at Queen's Park and West Kilburn urban centres arising from the Proposed Scheme.

Old Oak Common station

8.3.4 Significant land levelling works are proposed at Old Oak Common station. These works will therefore change the natural overland flowpaths and the location of predicted surface water flooding.

8.3.5 Post-development ground levels will be approximately 25.5m AOD for the majority of the land above the Old Oak Common station box. Ground levels will increase to approximately 26.6m AOD surrounding the main station building at the centre of the excavation. Access to the site will be via the highway in Old Oak Common Lane to the west of the station. There are no distinct flowpaths crossing the Old Oak Common station site, and the surface water flood risk at the shafts and station building is therefore unlikely to increase.

8.3.6 Surface water will be collected in the station drainage network and attenuated up to the 1 in 100 years return period (1% annual probability) rainfall event including an allowance for climate change. Attenuation volumes up to a maximum of 7,100m^3 are proposed in the vicinity of the station. The design states that the provision of SuDS

should be considered, such as green roofs/porous paving. Attenuated surface water will be discharged to the local TWUL sewer network at an assumed rate of 40.5 l/s. Any connection will be agreed in advance with TWUL.

8.3.7 The Proposed Scheme will therefore not lead to a change in the risk of flooding from surface water sources at Old Oak Common station. There will therefore be no adverse effects on the risk of flooding from surface water at Old Oak Common Network Rail depot, Wormwood Scrubs Common or East Acton urban centre arising from the Proposed Scheme.

A4000 Victoria Road Bridge

8.3.8 The widening of the A4000 Victoria Road is proposed to accommodate traffic requirements for Old Oak Common as development proposals expect an increase in traffic movement. The design states that one half of the carriageway will continue to drain to the existing sewer network and the widened part of the road will be restricted to like-for-like runoff rates based on 50mm/hr. Oversized pipes in the order of 1050mm in diameter will be required in order to achieve the attenuation required.

8.3.9 The Proposed Scheme will not lead to any increase in the risk of flooding from surface water sources at the A4000 Victoria Road Bridge.

Victoria Road crossover box

8.3.10 Ground levels will be reinstated following construction, with two permanent headhouses present on the ground surface. Other above ground works in this area are not known at this stage, however, surface water runoff routes will not be significantly affected.

8.3.11 The Proposed Scheme will therefore not lead to a change in the risk of flooding from surface water sources at the Victoria Road crossover box. There will be no displacement of floodwaters arising from the Proposed Scheme. Therefore no significant effects will be expected on the risk of flooding from surface water to the North Acton industrial area as a result of the Proposed Scheme.

8.4 Impact on risk of flooding from groundwater

8.4.1 Neither the Proposed Scheme nor the construction activities are expected to penetrate into the water bearing chalk strata within CFA4. Therefore the Proposed Scheme will not lead to a change in the risk of flooding from groundwater.

8.5 Impact on risk of flooding from drainage systems

8.5.1 Connections to the foul and surface water sewer network from the shaft and station headhouses within the study area will be agreed with TWUL prior to construction. There will not be a significant increase in the area of impermeable surface following construction as the sites have been previously developed. The Proposed Scheme will therefore not lead to a change in the risk of flooding from drainage and sewer systems.

8.6 Impact on risk of flooding from artificial sources

Canals

8.6.1 The twin bored tunnels and the single bored tunnel of the HS1-HS2 Link will cross and run beneath the Grand Union Canal (Paddington Branch) for approximately 340m (combination of three tunnels), as shown on Map CT-06-008, E7 (Volume 2, CFA4 Map Book). Ground settlement of over 30mm is predicted to occur at the surface as a result of the tunnelling works with the possibility of movement of the canal retaining walls and reduction of canal freeboard. An impact assessment of the retaining wall at Old Oak Common concludes that the predicted risk of damage to the masonry Old Oak Common retaining walls due to excavation of the tunnels is negligible.

8.6.2 The canal also lies within the settlement contour of the Old Oak Common station excavation, as shown on Map CT-06-008, B6 (Volume 2, CFA4 Map Book). Ground displacement around the retaining structure of the canal is expected as a result of excavation to construct the Old Oak Common station box. The 10mm settlement contour crosses the canal over a distance of 150m and the contour extends halfway across the canal.

8.6.3 As a result of the Proposed Scheme there is the potential for two changes to the residual risk of flooding from the canal. The excavation adjacent to the canal will increase the likelihood of a failure of the retaining wall during construction. Structures surrounding the proposed excavation during construction will be provided to protect the construction from flooding. These will alter surrounding overland flow mechanisms thereby potentially increasing the depths of flooding to the north of the excavation.

8.6.4 Hydraulic modelling has been undertaken to assess the depths and extent of flooding due to a breach of the canal during the construction phase when the Old Oak Common station box will be excavated. The modelling demonstrates that if canal waters were to be released, protection measures will be required to prevent the excavation from flooding. The modelling, however, also shows that these protection measures will increase flood depths to the north of the excavation as a result of restricting the flow of flood water to the east. Depths of predicted flooding down-gradient on the GWML and Wormwood Scrubs Common will not increase during construction and will decrease in some locations.

8.6.5 Although the excavation work will increase the risk of flooding from the canal during construction, it is considered that the majority of any ground movement associated with the Proposed Scheme will be during this construction period. Long-term settlement may occur but it is considered that there will not be a permanent increase in the risk of flooding from the Grand Union Canal (Paddington Branch) in this location.

8.6.6 Following the excavation of the station box at Old Oak Common, the construction proposal is to restore the ground level above the station and high speed train platforms. Ground levels will be approximately 25.5m AOD for the majority of the land above the station with elevated ground levels at approximately 26.5m AOD surrounding and including the station building.

8.6.7 For the operational case, the depths of flooding in the vicinity of Old Oak Common will be similar to pre-construction levels. There is a slight increase in the extent of flooding over the station excavation where the finished ground level is slightly lower than existing levels. Flood depths are expected to be shallow and the main entrance to the station will be raised by 1m above surrounding ground levels. There will be no significant change in the extent or depth of flooding to local receptors including the properties to the west of Wormwood Scrubs Common from the existing condition.

8.6.8 The Proposed Scheme will therefore not lead to a permanent change in the risk of flooding from canals.

Impounded reservoirs

8.6.9 As the route will not cross any areas that are shown to have a residual risk of flooding from failure of impounded reservoirs within the study area, the Proposed Scheme will not lead to a change in the risk of flooding from reservoirs.

Water mains

8.6.10 The potential damage to TWUL assets will be assessed prior to construction, and measures put in place to prevent the failure of any water main. Water main diversions will be constructed using appropriate materials and methods to ensure that the risk of failure is minimal.

8.6.11 The Proposed Scheme will therefore not lead to a change in the risk of flooding from water mains.

8.7 Summary of potential impacts and effects on flood risk

Table 6: Summary of potential flood risk impacts and effects in CFA4

Receptor	Vulnerability classification	Pathway	Impacts and effects
General Proposed Scheme	N/A	River	No significant effects expected.
		Surface water	No significant effects expected.
		Groundwater	No significant effects expected.
		Drainage systems	No significant effects expected.
		Artificial sources	No significant effects expected.
Queen's Park and West Kilburn urban centres	More vulnerable	Surface water 30 years - deep	No significant effects expected.
Old Oak Common railway depot	More vulnerable	Surface water 30 years - shallow Grand Union Canal (Paddington Branch)	No significant effects expected.
Wormwood Scrubs Common	Water compatible	Surface water 30 years - shallow Grand Union Canal (Paddington Branch)	No significant effects expected.

Receptor	Vulnerability classification	Pathway	Impacts and effects
East Acton urban centre	More vulnerable	Surface water 30 years - deep	No significant effects expected.
North Acton industrial area	Less vulnerable	Surface water 30 years - deep	No significant effects expected.

9 Conclusions

9.1 Summary

9.1.1 The Proposed Scheme within CFA4 extends from Kilburn to the North Acton industrial area. The study area includes all areas within 500m of the Proposed Scheme, which includes:

- areas at risk of surface water flooding in Kilburn, Kensal Rise, Old Oak Common and Victoria Road;
- areas with a residual risk of flooding due to the failure of the Grand Union Canal (Paddington Branch); and
- areas with a residual risk of flooding due to the failure of trunk water mains.

9.1.2 The Proposed Scheme will be at least 1m above design flood water levels within all areas at risk of flooding from river, drainage and artificial water body sources. Residual risks from these sources will be negligible.

9.1.3 CFA4 is heavily urbanised, with substantial residential and industrial areas. There will be no third party receptors that would be significantly affected by the Proposed Scheme.

9.2 Residual flood risks to Proposed Scheme

Grand Union Canal (Paddington Branch)

9.2.1 The residual risk of flooding to the Proposed Scheme as a result of a breach of the Grand Union Canal (Paddington Branch) is considered in Section 6.6 of this report. Threshold levels of the station will be raised which will prevent ingress of breach flood water into the station building and tunnels.

9.3 Residual changes in flood risk due to Proposed Scheme

Grand Union Canal (Paddington Branch)

9.3.1 The residual changes to the risk of flooding from a breach of the Grand Union Canal (Paddington Branch) as a result of the Proposed Scheme are considered in Section 8.6 of this report.

9.4 Compliance with local planning policy

9.4.1 The Proposed Scheme includes an allowance for future increases in the risk of flooding as a result of climate change by adding a 20% increase to river flows and a 30% increase to rainfall intensities and flows in minor watercourses as recommended in the NPPF Technical Guidance document. Attenuation will be provided to ensure that the rate of runoff from permanent infrastructure, such as at the Salusbury Road vent shaft and will not increase as a result of the Proposed Scheme. This will ensure that there will be no increase in the risk of surface water flooding, especially in areas where a risk currently exists.

9.4.2 The Proposed Scheme will be in compliance with the recommendations of the local authority SFRA reports, core strategies and other local planning documents.

10 References

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